



# St. Xavier's College – Autonomous Mumbai

## Syllabus For 1<sup>st</sup> Semester Courses in **LIFE SCIENCE** (June 2013 onwards)

### Contents:

Syllabus (theory and practical) for Courses:

S.LSC.1.01: Fundamentals of Biochemistry and Analytical Techniques

S.LSC.1.02: Genetics and Evolution

Template of Theory Question Paper

Examination grid

## LIFE SCIENCE

F.Y.B.Sc.

Course Code: S.LSC.1.01

**Title: Fundamentals of Biochemistry and Analytical Techniques**

### Learning Objectives:

The course aims to:

- Introduce the students to fundamental chemical processes and interactions that prevail in living systems
- Familiarize the students with biological molecules that are crucial for the maintenance of structure/function in an organism
- Introduce the students to the tools that may be used in the study of biomolecules and cells

**Number of lectures: 45**

### UNIT I

**(15 lectures)**

1. Types of Bonds: Covalent And Non-Covalent (1)
2. Physiological Role of Water: (4)
  - a. Structure of water
  - b. Dissociation and Ionic Product
  - c. Ionic interaction with water
  - d. Concept of pH and Buffers
  - e. Buffering Systems in a living cell
3. Carbohydrates: (5)
  - a. Classification & structure of Carbohydrates.
  - b. Monosaccharides: (i) Aldose & Ketose (one example each)  
(ii) C3 to C6 (one example each)
  - c. Disaccharides: Maltose, Cellobiose, Lactose & Sucrose
  - d. Polysaccharides: Starch, Glycogen & Cellulose
  - e. Properties & Reactions of Glucose & Fructose:
    - i. Isomerism
    - ii. Oxidation & Reduction
    - iii. Esterification
    - iv. Glycoside formation.
4. Lipids: (5)
  - a. Bloor's classification of lipids
  - b. Simple lipids (one example each).
  - c. Complex lipids (one example each)
  - d. Derived lipids (one example each)
  - e. Fatty acids: Types, nomenclature & properties (upto C18)

### Unit II

**(15 lectures)**

1. Amino acids and Proteins: (7)
  - a. Classification and Structure of Amino acids, and concept of iso-electric pH
  - b. Chemical reaction with acid/alkali, Ninhydrin, Sanger's reaction
  - c. Classification of Proteins based on function & shape
  - d. Protein Structure: Primary structure and the concept of 'N' and 'C' terminal, peptide bond formation, characteristics of peptide bond, secondary structures:  $\alpha$  helix &  $\beta$  sheets, tertiary & quaternary structure

2. Nucleic Acids: (8)
- Structure of nucleosides and nucleotides
  - Structure of a poly nucleotide
  - Forms of DNA: 'A', 'B' and 'Z'
  - Types of RNA: mRNA, tRNA, rRNA, snRNAs
  - Differences between DNA and RNA

**Unit III (15 lectures)**

1. Separation of organelles: (2)
  - Differential centrifugation
  - Density gradient centrifugation
2. Separation of Macromolecules: (6)
  - Salting in and Salting out
  - Paper chromatography
  - Thin layer chromatography
  - Electrophoresis
3. Colorimetry: (2)
  - Beer Lambert's law & principle of a colorimeter
4. Microscopy: (5)
  - Principle of Light Microscopy
  - Introduction to Electron microscopy: SEM, TEM, Fluorescence microscopy and Confocal Microscopy

**Course S.LSC.1.01 Practicals**

1. Concepts of Molarity/Normality and osmosis. Effect of different concentrations of dextrose/ NaCl on RBC.
2. Preparation of different buffers and measurement of their pH.
3. Verification of Beer's Law
4. Separation of amino acids using ascending Paper Chromatography.
5. Estimation of proteins using Biuret method
6. Qualitative Analysis- Sugars(mono & disaccharides, ketose & aldose, reducing & non-reducing) Proteins & Lipids
7. Density gradient centrifugation using sucrose.
8. **Group Projects:**
  - Qualitative analysis of components in different food samples.
  - Paper chromatography of natural extracts.
  - Determination of pH of different natural solutions.
  - Determination of  $\lambda$  max of different solutions/ any extract.
  - Any other.

**References:**

1. Biochemistry (2006), U. Satyanarayan, Allied Publishers
2. Textbook of Biochemistry, 3<sup>rd</sup> Ed.( 1961), E.S. West and W. Todd, Mcmillan, NY
3. Harper's Physiological Chemistry 22<sup>nd</sup> Ed.(2) ,
4. Biochemistry, A.C. Deb, Books and Allied Publ.
5. Outlines of Biochemistry 5<sup>th</sup> Ed., E.E. Conn, P.K. Stumpf, Wiley Publishers

## LIFE SCIENCE

F.Y.B.Sc. :

Course Code: S.LSC.1.01

**Title: Genetics and Evolution**

### Learning Objectives:

On successful completion of this module it is expected that students will be able to:

1. Articulate Mendel's "laws" and explain the evidence for it
2. Define, differentiate, and utilize terminology associated with Mendelian genetics.
3. Utilize Punnett square, forked line, and probabilistic methods of calculating expected ratios of offspring.
4. Construct and analyze pedigrees to determine patterns of inheritance, genotypes, and probabilities.
5. Understand that not all genetic traits are inherited in Mendelian fashion.
6. Explain how life might have originated on this planet
7. Describe Darwin's theories and how the principles of natural selection can lead to speciation.

**Number of lectures: 45**

### UNIT I

**(15 Lectures)**

1. Gene as a unit of heredity: Organisation of genes on chromosomes: (6)
  - a. Structure of a Prokaryotic genome: eg; *E.coli*
  - b. Structure of a Eucaryotic genome: packaging of DNA to chromosome
  - c. Evidence of DNA as genetic material: Griffith's experiment, Avery & Mcleod's experiment
2. Mendelian Inheritance: (8)
  - a. Concept of alleles, dominance & recessivity, homozygous, heterozygous, phenotype, genotype
  - b. Mendel's laws: Law of segregation of alleles, Law of Independent Assortment
  - c. Monohybrid, dihybrid and trihybrid ratios: test cross and self cross, Punnet square and branch diagram for determining ratios of genotypes and phenotypes, chi square analysis for mono-hybrid and di-hybrid ratios
3. Concept of cytoplasmic inheritance (1)

### UNIT II

**(15 Lectures)**

1. Extensions of Mendel's laws: Incomplete dominance; co-dominance (10)  
multiple genes; Multiple alleles; Lethal alleles; Gene interactions: Epistasis- dominant and recessive; Penetrance and expressivity; Extrinsic factors- temperature, nutrition; Intrinsic factors- Sex (sex limited; sex influenced), age; Pleiotropy
2. Study of human pedigrees: Modes of inheritance: sex-linked dominant & recessive  
autosomal dominant & recessive (4)
3. Concept of Karyotype: The Human Karyotype (1)

### Unit III

**(15 Lectures)**

1. Origin of life
  - a. Theories of origin of life: Overview of Creation myths/ Divine creation; Spontaneous generation; Cosmozoic hypothesis; Steady state; Biochemical origin. (2)
  - b. Biochemical theories: Origin of macromolecules; Miller's experiment; RNA world (2)
  - c. Origin of cells: Protocells; Coacervates; Microspheres; Prokaryotes, Eukaryotes (3)

## 2. Evolution

- a. Pre Darwinian ideas; Darwin's theory of natural selection, evidences and objections (2)
- b. Evidences for evolution (2)
- c. Speciation: Concept of species: Physiological species, Biological species, evolutionary species; Significance of speciation (2)
- d. Speciation and macroevolution: Allopatric, sympatric, and parapatric; (2)

### **Course S.LSC.1.02 - Practicals**

1.  $\chi^2$  test on actual data eg. Blood groups, widow's peak, tongue rolling, color preferences
2. Study of various Drosophila Mutants
3. Study of Sickle cell anemia - Slides/Photos
4. Study of human Karyotype
5. Pedigree Analysis
6. DNA Extraction + DPA test
7. Preparation of media for drosophila and study of its life cycle
8. Literature search on PUBMED for a genetic disorder: write out 10 references and abstracts on a topic

### **References:**

1. "Genetics – A conceptual approach"- Benjamin Pierce 3<sup>rd</sup> Edition (2008)
2. "Genetics- A molecular approach" Peter Russell 2<sup>nd</sup> edition, Pearson International(2006)
3. "Principles of Genetics"- Snustad and Simmons, 3<sup>rd</sup> edition (2003)
4. "Genes VI"- Benjamin Lewin (1997).
5. "Cell Biology, molecular biology, evolution and genetics" Varma and Aggarwal
6. "Concepts of Genetics"- W.S. Klug, M.R. Cummings, C.A.Spencer. 8<sup>th</sup> edition, Pearson Education International (2006)
7. "Introduction to Genetic Analysis"- A.J. Griffiths, S. R. Wessler, R.C. Lewontin, S.B. Carroll. 9<sup>th</sup> edition, Freeman and Company (2008)
8. "Molecular Biology of the gene"- J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M.Levine. 5<sup>th</sup> edition, Pearson Education (2004)
9. "Genetics": The Continuity of Life"- D.J. Fairbanks, W.R. Andersen, Brooks/Cole Publishers (1999)
10. "Strickbergers evolution: the integration of genes, organisms and population, Brian K. Hall, B. Halleirmsson, 4<sup>th</sup> edition, Jones and Barlett Publishers. (2008)
11. "The World of Biology", Solomon E.P., L.R. Berg, 8<sup>th</sup> edition, Sanders College publishing(2008)
12. Essential Biology , N. A. Campbell , J.B. Reece, L.A.Umy, M.A. Cain et al, 8<sup>th</sup> ed, Pearson Benjamin Cummings (2008).

## Template of Theory Question paper Courses S.LSC.1.01 & 1.02

### **CIA I – 20 marks, 45 mins.**

**Unit I:** Objectives/Short questions, not more than 5 marks each

### **CIA II – 20 marks, 45 mins.**

**Unit II:** Short questions/Presentation/Assignment, not more than 5 marks each

### **End Semester exam – 60 marks, 2 hours**

There are three units and three questions, one per unit.

The Choice is internal- i.e. within a unit and could be between 50% to 100%

FYBSc LifeScience - 1.01 and 1.02 Exam Grid					
Course	Exam	Knowledge and Information	Understanding	Application/Analysis	Total
<b>1.01</b>	CIA I	8	8	4	20
	CIA II	8	8	4	20
	End sem	18	18	24	60
Course	Exam	Knowledge and Information	Understanding	Application/Analysis	Total
<b>1.02</b>	CIA I	10	7	3	20
	CIA I	10	7	3	20
	End sem	30	20	10	60